The Impact of Web-Based Learning with a Problem-Solving Approach on Logical Thinking Development

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Abstract
This study is aimed to assess the impact of web based learning (weblog) with a problem-solving approach on logical thinking development among students of industrial engineering of Islamic Azad university of Sirjan. The method for gathering data was based on questionnaire that were designed by Kember et al. (1999) which is based on Mezirow theory (1991), that was by one pre-test and one post-test which were conducted for both experiment (N=15) and control groups (N=15) who were selected by cluster sampling method. Results of this assessment showed that there is a significant difference between experiment and control group that these differences were concerning understanding, reflection, and critical thinking (P<0.05). Therefore we can conclude that using web search has a positive effect on student's logical thinking ability.

Keywords: Mathematics education, web-based learning, problem-solving approach, Mezirow theory, critical thinking.

1 Introduction
The main characteristic of a human being is his power of thinking and also education is a process which improves human's thinking. The importance of thinking is so great that it is impossible to live without it. The main goal of any thoughtful educational system is to education thoughtful individuals. Dewey (1993), pointed out the importance of thinking and considered to begin thinking is to deal with a problem and knows it as a problematic situation. He believes that the start of thinking is doubt, ambiguity or perplexity [5]. Thinking itself doesn't appear and also doesn't appear on the base of "general principles"; but always it's evident that it provokes. If we ask a child, who does not face any difficulty in his experience which inspire him or maybe bother him, we did a wasteful job. Although all trainers mentioned the significance of thinking but a few of them have attempted to presentation basic procedure
for improving it. Various strategies have been proposed to enhance thinking: logical behavior, critical analysis and problem-solving are among these proposed strategies. People like Kember et al. (1999) based on Mezirow theory tried to create a tool for measuring the quality of logical thinking at university, which is partly influenced by the ideas of Dewey (1993) [9]. Logical thinking before was being conducted by tools such as Kornel's critical thinking test and Gliser's critical thinking assessment. Even now we don't have effective methods for logical thinking or people who are responsible in this field don't accept them as an effective method or they choose methods that don't have any special effect on logical thinking [8]. Thus studying such topics at university is necessary because university a place for improving our thinking skills in higher levels and this requires choosing some technologies like the internet that gives students a lot of information so that students on the base of logical thinking are able to distinguish pure from impure. Amanda et al. (2001) cited that internet by removing lace and time limitations in traditional classrooms, provide such an opportunity, also most of researches today shows the increasing use of internet by young people and their positive point of view [1]. The studies which conducted in Iran (2002) also shows that 41% of high school students have access to the internet and According to the same survey, 78 percent of teachers know internet as a useful device. Hong, Ridzuan & Kuek (2003) showed that university students have a positive perspective about using internet and of course it's usage in learning (Oral, 2008) [13,11]. Systematic use of ICT in teaching and learning is called "e-learning" and it's purpose is to develop "situational learning". According to this theory, learning is more effective just when the learner is in a real situation and the subject is based on the learners' ability. Internet is a useful tool that can provide these kind of learning which is based on some special features as following: a) removing time limitations from teaching, b) removing place limitations from teaching, c) learning based on self and individual talents, d) providing a situation for discussing different ideas, e) increasing both the quality and the duration of education, and f) to teach the advantages of research. Perhaps the first and the most important role of scientific weblogs and especially mathematical weblogs in internet, is to develop informal math skills for non-school learners. These weblogs have an important role in 1) expressing and also solving different math problems in different levels such as: university, high school, secondary school, and in general 2) expressing interesting tips about math and their role in different fields of math like the theory of numbers, 3) having variety in teaching different fields such as: statistics, operation research, games theory and etc…, 4) expressing the history of math in Iran and in the world, and expressing the history of mathematical discoveries and telling some interesting stories about biography of mathematicians and finally providing unknown usages of math and its effects on daily life and also they have an important role in introducing various aspects of mathematics in society. It is in a way that they have the same number of users as the official sites have. The easy and simple design of weblog that isn't as hard as designing a new site is the reason which causes to increase the amount of essays and also significant increase of the web Persian content in the field of math in internet. The first Persian weblog in Iran was started working since September 2001 and today millions of people are among its users. One of the factors that led to the everyday popularity of these weblogs is their special characteristics as following: quick set up and easy use and also they don't need any special software or skill for using. Everybody uses these weblogs for specific purposes, and also it can be used for education and it can be used for increasing learning opportunities. Using scientific facts have a direct relationship with student's way of thinking. Consequently, teachers need to think again about their role and they should focus on teaching some skills that improve student's ability for critical thinking. Also there are some theories that support these processes such as cognitive theory, meta- cognitive and
structuralism based theories. Although these theories differ in some aspects, at the whole everybody believes that in education, we should find students as an active participant in these situations and with creating some opportunities and a good situation for discussing problems, we can improve student's ability for critical thinking. The main point that we should consider in teaching-learning processes is that we can't limit the ability of thinking to some limited situations. Also it isn't possible to improve student's thinking especially the ability of critical thinking just with the process of transferring and saving some information. In relation to these theories, experts believed that, the best way to improve critical and logical thinking is using web with the method of problem solving. On the base of previous researches in this field, it seems that nowadays, weblog on the base of its characteristic is a good opportunity which can be useful in improving students' ability for thinking. The aim of this research is as following first expressing Dewey's and Mezirow theory about critical thinking and then because this research is conducted on the base of Mezirow theory we express his idea completely and then we focus our attention on the weblog and its role in thinking and also the effects of it on the math teaching.

2 Logical Thinking From Dewey's Point of View

Logical thinking on the base of Dewey's point of view (1993) is exact stable and of course active analyzing of each opinion. He knows logical thinking as a kind of thinking and explains that there are other kinds of thinking and like thinking process that is include useless thinking's and random reminds but he knows this kind of thinking completely separated from other kinds from this perspective logical thinking is include following characteristics:

- Lack of certainty and dilemma,
- Searching for a solution to make the mind relaxed.

Dewey (1993) pointed out that logical thinking is not required in all situations, but also logical thinking is a special kind of thinking for special conditions, the conditions that under which various solutions are being considered. For Dewey (1993), logical thinking is an exact significant system of an ambiguous situation where there are different solutions for the reaction to act accurately. Dewey (1993) states that when a person is faced with a situation where it is more a state of doubt, uncertainty or fear, logical thinking begins and the person decides to solve it. There are three attitudes that affect the person's decision about the problem that he faces which are as following: mind limitations, interest, enthusiasm and responsibility. In addition to attitudes which mentioned, Dewey (1993) knows some other factors like background knowledge and judgment which affect on the logical thinking. Dewey's (1993) knows mind limitations factor as having two characteristic like following: 1) the limited perspective about thinking to new problems and attention to new perspectives, and 2) active search for new ideas. The definition of mind limitations believes to this idea that always there is more than one possible solution. A person who opens minded always accepts that maybe his solutions to some problems are incorrect, so he analyzes various solutions about the problem. Mind limitations let person not seeing a problem just from one point of view and the person can have attention to the other solutions. The second factor for Dewey (1993) means that enthusiasm and ambitions don't let the person to think about another solution and the third factor includes responsibility and having harmony with various beliefs that cause an assurance for person. In addition to the impacts of individual attitudes, Dewey (1993) also states that background experiences have some effects. Dewey (1993) argues that a person's past experiences, such as attitudes, will affect the whole process of logical thinking. In particular, he states that a person's background experiences can directly affect to the possible solutions for a problem. Because the ideas related
to problems which faced by the solutions couldn't be created by themselves. The Third part of logical thinking from Dewey's point of view is judgment that is the process of gaining meaning from the data when a person face a problem that should find a solution for that problem. Judgment is include analysis (which determine data that are unknown) and combination (which combine data that are not in accordance with each other). Judgment includes selecting a person among facts, ideas, and opponent's suggestion for finding a solution for problem. Thus, a person's judgment will affect on his choices.

3 Logical Thinking From Mezirow's Point of View

Mezirow confirms Dewey's point of view about logical thinking and states that logical thinking is a valid assessment (Kembar et al., 1999). Transformational Learning Theory affects on Mezirow's approach on the base of logical thinking. Transformational learning refers to the learning processes which lead to the changing of significant plans and also significant views. Although, ideas are not transformative. Some logical thinking levels lead to changing perspectives because it needs a prior assessment process. These assumptions are evaluated on the base of the resolution conflict between personal experiences and meaningful plans. In this process of critical thinking, the old educational systems will be affected by new solutions. In Mezirow's opinion critical thinking about assumptions is a changeable process of meaning related, that is consistent with past emotional experiences. These experiences can affect decision making process when a person focuses on specific solutions and do not attention to the other solutions. In his perspective, there are seven levels of logical thinking. The first three levels are a collection that he calls them non-logical thinking and are as following: Acts according to habits, works on the base of understanding and inner thoughts. The other four levels are defined as levels of logical behavior. The first three levels are content, process and combination of these two. The final level which is thinking about hypothesis shows the highest level of logical thinking.

4 Weblog and Its Role in Education and Thinking

One of the ways of improving thinking abilities is to face individuals with problems this process will force person to thinking. Dewey (1993) states that "If we ask a child or even an adult to think deeply because there wasn't anything bothering in his experiences our work is useless". Sevelj (2006) says that, weblogs as a modern technology by providing enigmatic opportunities helps to improve the ability of thinking. Weblog provided opportunities to share our thoughts with the world, comments and feedbacks about these thoughts, cause individuals to review the experiences and so it helps to the development of logical thinking [15]. In education system, people need to be involved in an activity and with discussion get new information. individual thinking is an important teaching strategy for helping to the students intellectual insight and critical thinking skill is necessary for a complete understanding of the data (Ganley, 2004; Fernheimer & Nelson, 2005; Stiller and Phillo, 2003; Brooks, 2003) [7,5,6,2]. Unfortunately, most teachers don't attention to the importance of thinking with this view that it happens by itself. But it should be noted that thinking can't be formed in a limited space and it needs an active situation. Weblog and its facilities provide a suitable situation for logical thinking. Weblogs are used differently for training. Oravec (2003) states that teachers can use weblogs in teaching through following strategies:
Using web for students' homework: Students get other people's opinions in class and even people outside of the classroom (like parents). Students are able to see their developments during a period of time,

- Exchanging links: teachers can take creating a weblog,
- Homework or their everyday activity: students can interest and use useful websites by the help of their classmates through their own weblogs. Weblogs let the students to provide a personal background for their comments,
- Improving logical processes in teaching methods: combinational learning approaches can show people classification of learning types. Training weblogs can improve critical thinking based on these styles this is when people shared their experiences in classroom [12].

5 Research Hypotheses

I) Is there any difference on the base of their marks and logical thinking's 'habitual behavior test' between students who studied in traditional system of education and students who studied based on weblog?

II) Is there any difference on the base of their marks and logical thinking 'understanding test' between students who studied in traditional system of education and students who studied based on weblog?

III) Is there any difference on the base of their marks and logical thinking of 'thinking and contemplation test' between students who studied in traditional system of education and students who studied based on weblog?

III) Is there any difference on the base of their marks and logical thinking of 'critical thinking test' between students who studied in traditional system of education and students who studied based on weblog?

6 Methodology

This paper is a quasi-experimental with posttests and pretests. Quasi-experimental method is more suitable when the subject of study is human. It's not possible to change the variables tries to make the research more close to the real empirical method. Although in this situation, researcher tries to analyze and study the following situation as a natural or sociable situation.

7 Participants

The population in this research is included all undergraduate students of industrial engineering in Islamic Azad university of Sirjan (2012-2013). Total number of students is 170 (74 boys, 96 girls totally; 6 classes). Sampling method in this study is randomized cluster sampling. Sampling unit is classroom so we select a class randomly. In the selected group, the number of girls is more than boys. However, sample is divided into experiment and control groups in terms of their willingness and interests but being a member of experiment group requires having a computer and a series of features like internet connection as well as skills for working with computer and knowing how to work with internet. So selecting members randomly was not possible. Then a series of pamphlets about how to work with internet were given to the experiment group. All students in sample group, were 30 persons that of these 30 student, 15 of people were selected as experiment group and 15 of people were chosen as control group.
8 Instruments

Gathering information in this study, was done on the base of logical thinking questionnaire which is designed by Kember et al. (1999) and is based on the theories of Dewey and Mezirow (Lucas & Tan, 2006) [10]. This test has four levels which are 'habitual action', 'understanding and comprehension', 'reflection and logical thinking' and 'critical thinking' and totally the test has 16 questions on the scale of 5 from Likert's scales [9]. At the first session, questionnaire was completed by students in both control and experiment groups and their tendency for logical thinking were recorded. In the control group, the traditional method of teaching was continued until the end of the term, but in the experiment group, there were some practices that students were supposed to do them on the base of weblogs. During 14 sessions, there were different problems that students encounter and they were supposed to deal with them at the end of session 14, we gave questionnaire to the students and the results in both groups were recorded. On the base of this questionnaire and using it for 265 students, the alpha rate for 'habitual action' level was 62%, for 'understanding and comprehension' level was 75%, for 'reflection and logical thinking' was 63% and finally for 'critical thinking' was 67%. Also the results of research on 30 students shows the rate of stability with the use of Cronbach alpha for 'habitual action' level 65%, for 'understanding and comprehension' level was 74%, for 'reflection and logical thinking' level was 81% and finally for 'critical thinking' was 74%. Scoring in this questionnaire was on the base of following scores for each alternative: for first option; (completely agree), second; (agree), third; (I don't have any idea), forth; (disagree), fifth; (completely disagree).

9 Statistical Methods

In this study, we used of descriptive methods and also mean and standard deviation. However for analyzing research hypotheses, we used inferential statistics as follows. Because the test scores were consistent and logical thinking had a normal distribution. We used of parametric statistical tests. Because there was two independent and control groups, for analyzing the difference between two groups, we used of t-test for independent groups. Also for analyzing educational development, we used of final exam results because of determining their level of logical thinking. At the end, after comparing different results between groups results, were analyzed separately.

10 Findings

To compare the mean pretest scores and both control and experiment groups independent sample t-test was used. To conduct this test, the variances' homogeneity test of both experiment and control groups were studied. Regarding that F statistics' significance level related to this test was more than 0.05, so assumption based on variances homogeneity was accepted and with assumption of variances homogeneity, t-test results of independent groups, as described in Table 1, were obtained by separating several levels of logical thinking, respectively. As observed in Table 1, P-values obtained in thinking level 'habitual action' was more than 0.05 between experiment and control groups. Therefore it also is inferred that the two groups aren't significantly different before starting experiment from view point of thinking level of 'understanding and comprehension' and were somewhat identical (P>0.05). In addition in thinking level of 'logical thinking' between both control and experiment groups, it is also inferred that the two groups aren't significantly different before starting experiment from view point of thinking level of 'logical thinking' and were somewhat identical (P>0.05). Moreover, in thinking level of 'reflection and reasonable thinking' within two control and experiment groups, it can be inferred that the two groups aren't significantly
different before starting experiment from view point of thinking level of 'reflection and logical thinking' and were somewhat identical (P>0.05). As well finally in thinking level of 'critical thinking' within two control and experiment groups, it can be inferred that two groups aren't significantly different before starting experiment from view point of thinking level of 'critical thinking' and were somewhat identical (P>0.05).

Table 1: Results of studying pretests in four levels

<table>
<thead>
<tr>
<th></th>
<th>Habitual Action Level</th>
<th>Understanding and Comprehension Level</th>
<th>Reflection and Logical Thinking Level</th>
<th>Critical Thinking Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Groups</td>
<td>N</td>
<td>Mean</td>
<td>T</td>
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<tr>
<td>Experiment groups</td>
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<td>13.73</td>
<td>0.99</td>
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<td>Control Group</td>
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<td></td>
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<tr>
<td></td>
<td>15</td>
<td>16.36</td>
<td>2.01</td>
<td>28</td>
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<tr>
<td></td>
<td>15</td>
<td>15.48</td>
<td></td>
<td></td>
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<td></td>
<td>15</td>
<td>17.33</td>
<td>1.58</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>16.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>14.08</td>
<td>-0.08</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>14.15</td>
<td></td>
<td></td>
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</table>

In inferential statistics section, research questions are studied. By posttest's comparison of experiment and control groups results shown in Table 2, indicate that two groups although aren't different from mean's point of view, but this difference isn't significant using t-test. That is resulted differences aren't important. Calculated T was obtained by (-2.46) with 28 freedom degree that isn't less than Table's T in significance level of (2.67) 0.001. So he is supported here and we find that two groups aren't significantly different from view point of 'habitual act' in pre and posttest. However answering this research question can't be positive. In level of 'understanding and comprehension', it is shown that obtained T (2.88) is more than Table's T (2.05), it means that with 95% confidence, it can be said that resulted changes aren't resulted from chance and error but it is a real difference. So answering this question is positive. Two groups are identical in any way expect independent variable, as a result it can be said that students who are taught in traditional classrooms by a web-based method, are different from students who are taught by a traditional method for average of grade in 'understanding and comprehension' level of logical thinking test and average of grades of students in experiment group is more than it in control group. In addition T resulted from comparing two groups in thinking level of 'logical thinking' in posttest show that two groups are significantly different, because calculated T (2.35) with freedom degree of 28 is more than Table's T (2.04) in 0.05 significance level. So by 95% confidence, it can be said that two groups are different and regarding that two groups are identical in all conditions except independent variable, as a result using independent variable causes to make a change in experiment group; and it is concluded that web-based learning by solving problem's approach affect students' logical thinking. Based on test, two groups are different in regard of having critical thinking, because calculated T (2.22) with freedom degree of 28 is more than Table's T (2.04) in significance level of 0.05. However with %95 confidence, it can be said that difference between two groups isn't from chance and error, but independence variable is the factor of this difference. Thus answering to research question is positive and there is a difference between 'critical thinking' of both groups and experiment group's mean is more than control's group. So, web-based approach is effective.
Table 2: Results of posttest studying in four levels

<table>
<thead>
<tr>
<th>Level</th>
<th>Groups</th>
<th>N</th>
<th>Mean</th>
<th>T</th>
<th>df</th>
<th>Sig</th>
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<tbody>
<tr>
<td></td>
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<td></td>
<td>Experiment</td>
<td>15</td>
<td>18.36</td>
<td>2.35</td>
<td>28</td>
<td>0.008</td>
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<tr>
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<td>17.61</td>
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<td>Experiment</td>
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<td>28</td>
<td>0.02</td>
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<td>Control</td>
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<td>16.53</td>
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<tr>
<td>Critical Thinking Level</td>
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<td>17.41</td>
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<td>0.03</td>
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<tr>
<td></td>
<td>Control</td>
<td>15</td>
<td>16.08</td>
<td></td>
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</tbody>
</table>

11 Conclusions

The role of internet in the present era and of course it's role in education is perhaps one of the few opportunities which is very useful in improving student's ability for thinking. Of course, today we can see the increasing use of internet in developed countries and there are different kinds of education with the use of internet such as: virtual universities, e-learning, and integrated education. These kinds of technologies and the usage of them in the education system show the importance of thinking and of course logical thinking. Because now a day, human information is increasing and there isn't any need for remembering them so the logical thinking should be improved in order to make humans capable for determining pure from impure. The results of this study, which shows the efficient use of weblog in education and its effect in development of logical thinking, are the same as results from Campbell research (2003) [3,4]. The results are also consistent with previous results from Stiller and Philleo research (2003). Their research shows that the students who worked with weblogs have a more wide scope of thinking in comparison to the students who don't. This is also confirmed in this study [15]. The results of the research are also consistent with previous results from Xie & Priya researches (2004). They found that most students have positive experiences about using weblogs and all of them speak about weblog as a useful instrument for improving their ability for thinking and also it helps them for a better learning situation [17]. Results of this study indicate that internet is the simplest and also the most useful instrument for virtual education which using it can help to the development of near future educations. Internet can decrease distances between students and teachers and of course it can eliminate time limitations the most and interesting aspect of using weblog is that with the increasing number of users there is no difference between the quality of facilities that it can provide for students and it can be the most interesting aspect of it. On the base of research results our suggestions for works related to students are as following:
- Attending some courses for students in order to teach them how that can work with internet,
- Providing facilities for students in order to use internet with low costs,
- Attending some courses for teachers in order to prepare them for teaching students,
- Making some weblogs for giving information to the students by educational groups.
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